1st North African Olympiad in Informatics
2025

The Dripping Tap

Time limit: 1 second **Memory limit: 256 MB**

A number of less than 1000 brainless prisoners are locked inside a prison. A warden gave them the following riddle, and if they solve it they will be freed from the prison:

The warden sets up a room with a whiteboard. Initially, the number 0 is written on it. A cycle is called to be the following procedure: The prisoners are to enter one by one in the room in a fixed order. All they can do upon entering the room is read the number currently written on the whiteboard and write another one in its stead, or declare the answer to the riddle. As they are brainless, they cannot remember the past information, so each time they leave the room they write an integer $-10^{18} \leq x \leq 10^{18}$ on their clothes to remember it the next time they enter the room (They do not erase the previously written numbers). If any prisoner chooses to do the latter, the game will end and no more prisoners will enter the room.

The game can, in total, take place over multiple cycles, i.e. after the first one ends, another may begin, and after that one ends, another can start and so on. For every reiteration of the cycle process, it is known that the prisoners will reenter in the same order they did as in the first cycle.

As such, the last number written on the whiteboard during some cycle will be the first number read by the first prisoner at the start of the next cycle (if there is a next cycle).

The purpose of this game is for the prisoners to find out how many of them are incarcerated, information which is obviously withheld from them at the beginning of the game. So the number that should be declared is the number of prisoners that partake in each iteration of the cycle.

All the inmates upon hearing the rules set by the warden decided to call their lawyer. All of them have the same lawyer, which is in fact you. You can now discuss with every prisoner and tell them all to respect one single strategy when playing this game. Of course, they trust you so they will behave in the exact way in which you tell them to.

Can you devise a strategy that will have both the prisoners freed and the maximal efficiency?

Scoring

There are two parameters to the efficiency of a strategy: The maximum absolute value of the number written on the whiteboard by any of the prisoners; M, and the number of cycles taken until the some prisoner declares the answer; C.

- If the strategy issued by the solution does not declare the correct answer for some test, you get 0 points
- Otherwise, you get $80 \times 1.02^{-\sqrt{max(M^2C-40,0)}} + 20$ points for that test.

The final mark is the minimum mark obtained over all the testcases.

Implementation

You have to implement the function : `tuple<char, long long, long long> prisonier(long long W, vector<long long> notebook)` that takes as parameter W the number currently written on the whiteboard, and notebook, the list of integers written on the prisoner's clothes in the same order they were written.
The function should return {'w', X, Y} to write X on the board and Y on the clothes, or {'a', X, 0} to answer X to the riddle.

Code Template

```
#include <bits/stdc++.h>
typedef long long ll;
using namespace std;

tuple<char, ll, ll> prisonier(ll W, vector<ll> notebook)
{
    return {'a', 1, 0};
}
```

Constraints

- Number of prisoners < 1000
- $-10^{18} \leq$ any written number $\leq 10^{18}$